—It would be more easy to state the grounds why I doubt the advantage of the 9-inch. Theoretically we know that a tube which presents the greatest area or the greatest friction to fluid passing through it, is that form of tube which is the least adapted for the conveyance of water. Take a 9-inch tube and fill it three-parts full, I apprehend there will be more friction upon the sides there than with a 12-inch tube containing the same quantity of water.

Will you describe the capacities of the ordinary inlets to this house drain; will there not be the sink in the kitchen, and occasionally the soil of the water-closet, supposing there to be a water-closet?—Yes.

Of course the flow from the water-closet is occasional?—Exactly.

For that you use a 4-inch soil-pipe?—Yes, vertical.

Why then do you use a 12-inch outlet, an outlet nine times greater than the inlet?—The outlets in some parts of it is nearly level, and it has other things to take besides the soil from the water-closet.

Take the inlet from the sink: through what sized pipes do the water sinks in use in your district drain?—About an inch and a half, or two inches at the outside.

What is the proportion of the size of the inch and a half pipe as compared with the 12-inch outlet?—A 64th part of it.

Do you think that an outlet 64 times larger than the inlet is necessary?—No."

Mr. Henry Austin, now the consulting engineer to the commission, advocates the use of small drains. When questioned as to the probable danger of their choking up, he said:—

"Under proper regulations, I am satisfied that no stoppage whatever would occur in any case. It is true that large substances of various kinds—broken china, cinders, oyster-shells, vegetable refuse, brushes, rags, and a host of other matters,—are constantly found in the sewers, being thrown, either carelessly or mischievously, down the yard drain, into the sink, or down the water-closet. It would be rather surprising if it were otherwise, for not the slightest precaution is used to guard against it. No immediate inconvenience results, and there is plenty of room and to spare, we may be sure, when we hear from the City Surveyor of Sewers, in his evidence before the Health of Towns Commission, that even coffins and tombstones, a bedstead, and the beadle of the parish, lie in them, to be detected only in general explorations. Under a proper regulated system, how easily would these abuses be prevented. Yard drains would not be left unprotected; sink gratings would be effectually secured: surreptitious openings would be impossible; and that form of water-closet basin which will admit of such an abuse, either from the carelessness of servants or the mischief of children, would be at once abolished. The common pan basin, as it is called, is subject to this inconvenience, by reason of its direct communication; but the syphon trap basin, which is more efficient with a good supply of water, and considerably cheaper, will not admit of the intrusion of such matters."

"What size of house drain do you consider would be generally sufficient?—I feel satisfied, from long consideration of the facts, and practical observation, that there are very few cases in which a 4-inch drain would not suffice; and if the practical men who contend for 9, 12, or 15-inch drains to houses, would only reason upon the subject for a moment, I am convinced that they must see the error of their practice. A 4-inch pipe with an inclination of 1 inch in 10 feet, will discharge about 14 cubic feet of water per minute; now, an extraordinary fall of rain, of 2 inches in an hour, will not produce above a fourth of this quantity on the space occupied by an average-sized house and yard. But it is argued that there must be great additional space in the drains to allow for obstructions, when, should deposit accumulate, there would still be some room left for the passage of the water; but if any deposit take place in the small drain, it is immediately choked. Compare the two cases:—A heavy substance gets into a 12-inch drain. The water from the house being diffused over so broad a bottom, has no power to move it, but a heavy shower may probably send it along some 20 or 30 feet, until it meets with an obstructing inequality. There it stops, a dam for the accumulation of all the soil, grease, and minor substances that, from day to day, are poured into the drain. This accumulation indurates and lengthens, until at last the water forms itself a small sinuous passage through the softest part. A heavy substance gets into a 4-inch drain, and a great power of water is every day concentrated upon it; but if this, by any possibility, should not be sufficient to send it forward, the first shower of rain will fill the drain, and accumulate a pressure of such a considerable column of water from the external openings of yard drain and rain-water pipe of the house or outbuildings, that no temporary obstruction can for a moment resist."

"There is another most important point with regard to small drains that is overlooked. Granting for a moment that the sectional capacity of a 4-inch drain is not equal to that of the waters that may flow into it from all the openings—sinks, ares, water-closets, and rain-water pipes—of such a large house as this (Gwydyr House); there would be a pressure of a column of water in the 4-inch drain, when flowing full—as it might in heavy storms—that would, from the increased velocity, render it more than equal for the time to the 9-inch drain as at present put in. I am fully prepared, therefore, to contend that there is scarcely a private house in this metropolis for which a 4-inch drain would not be sufficient, if correctly put in, and with all the junctions thereto securely made, with proper curves. We see that nature throughout, in its rivers and streams, meets its own exigencies in similar ways, but it is only seen to be disregarded. The fact is, that as 12-inch drains get constantly choked, it is hence inferred that they are too small, rather than too large. I am asked by one who should know better, 'How can a 4-inch drain be sufficient when I have a 12-inch in my house, and yet I am constantly flooded even with that?'—and I can only answer, 'that it is precisely because you have a 12-inch drain which is improperly constructed and nine times too large, that you are constantly flooded.' A great horror of cesspools is constantly expressed, and yet the whole present work of house-drainage is a system of nothing else."

The witness urged the value of glazed pipes, and points out, as one of their advantages the greater fall, in the case of house-drains, that can be obtained by means of their use than with a brick drain.

The same argument with respect to the erroneous size of house-drains holds good also with respect to the public sewers.

Building sewers for men to go into them to clear away deposit is the occasion of deposit. It is no more necessary for men to go into sewers than for climbing boys to go into chimneys.

Witness shewed that there are no sound and sufficient data for correctly determining the size of sewers, and urged the necessity of an extended series of observations and experiments.

When asked if he considered "the practice of constructing all the sewers of sufficient size to convey the waters of the greatest known storms to be correct?—Witness said,—decidedly not. The practice is most erroneous, and has tended to bring about the most unscientific treatment of the subject,—that of an equalized system of sewerage in the place of a graduated system. Nature points out to us, in all directions, that it is perfectly unnecessary. Every unsewered town of the kingdom is an illustration of the fact, that the provision of capacity of sewers, throughout the system, sufficient for the waters of extraordinary storms is a great error. This provision should be made only in the main natural valley and connecting lines, to which the waters immediately descend, and where the accumulation calls for an ample passage. In the higher portions of a district, even in the total absence of sewers, storm waters flow off immediately, and do no injury; while the provision of enormous size of sewer, for an event which happens only for a brief space in an interval of years, renders them unfit for their daily and constant purpose."

Mr. Roe, of the Holborn district, to whom much praise is due for many valuable improvements, gave some important evidence. He, also, advocates small drains, as we shall shew on another occasion.

Mr. E. Cresy, the author of the "Encyclopædia of Engineering," adduces a number of experiments and statements to prove (what is very important) that, when two streams of water, running with the same velocity, and having both their sectional areas equal, are united in one stream, their sectional area is not doubled. Thus, though three acres of land, for example, require one foot sectional area of sewer, double that quantity would not require two feet of sectional area. From M. Gennete's experiments on this head witness calculates that—

"12 houses would require a sewer $\frac{1}{4}$ larger only than would be required for one; 24 ditto $\frac{1}{2}$ ditto; 36 ditto, $\frac{3}{4}$ ditto; 48 ditto, 1, or double ditto; 60 ditto, $1\frac{1}{4}$; 72 ditto, $1\frac{1}{2}$ ditto; 84 ditto, $1\frac{3}{4}$ ditto; 96 ditto, 2,—or three times the original capacity.—Each of the 3-inch pipes which conduct the water from the houses has a sectional area of 7·0686 square inches, or 20 of them nearly occupy a superficial foot; notwithstanding this, they each are made to discharge themselves into a 12-inch barrel drain, the sectional area of which is 113·9976 square inches. Suppose, then, we apply our rule to the 12-inch barrel-drain, the capacity of which, no one will doubt, is sufficient to carry off the surplus waters from each house; we shall have to multiply 113·9976 by 3, which gives us the product of 341·9828 square inches, or 2·374 feet superficial. A barrel-drain having that area, then, would, according to M. Gennete's rule, be sufficient to carry away all that could pour down ninety-six 12-inch barrel-drains: although a drain 21 inches in diameter, whose sectional area is 2·4 feet, appears small for the purpose, yet it would be ample."

In addition to a number of translations and extracts bearing on the question, Mr. Cresy gives some very interesting details of the drainage of ancient buildings, such as the Colosseum, the Amphitheatre at Nismes, and the Amphitheatre at Verona, to which we may refer on another occasion. For the present we must quit the subject, leaving our readers to draw their own conclusions from what we have extracted, or, better still, from the perusal of all the evidence as published. The opinion of the surveyors of the Lambeth district is, doubtless, founded on strong conviction: the maintenance of it seems likely to cost them their appointments.

ROYAL INSTITUTE OF ARCHITECTS.

BUILDING STONES, &c.

AT a meeting held on the 24th inst., Mr. Charles Fowler, V.P., in the chair, Mr. W. W. Deane and Mr. H. Hodge were elected associates.

Amongst the donations were a number of works presented by M. de Caumont, the veteran archæologist of Caen,* and a portion of a mosaic pavement from Mr. Wallen, found 9 feet below the present level, in excavating for some new warehouses at the corner of Wood-street and Gresham-street, in the city.

From other remains discovered at the same time, the donor was disposed to conclude that a Roman temple formerly occupied the spot.

Professor Donaldson then read a very interesting paper on "Caen, its quarries and buildings, with a few words on Arras," which we have the pleasure to give in full. At the conclusion of the paper,

The Chairman, first complimenting Mr. Donaldson on the good use made of a short visit, which he hoped would serve as an example to other members—said, with reference to the

* At the previous meeting of the Institute, M. de Caumont was elected a corresponding member. Signor Bonucci, director of the excavations at, Pompeii, was also elected corresponding member.